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AGRICULTURAL RESEARCH AS A CAREER

THE production, storage and distribution of an adequate supply of food and raw materials constitute the primary function on which all civilization has been founded. The raw materials are at the present time of various kinds. Primarily they had to do with clothing and shelter, so cotton, wool, leather and wood have always been the major products. The number of products used for food and raw materials has increased from time to time and the proportion has varied as opportunities for new uses and wider distribution have developed. While adding to the total of production and consumption, they have not materially changed the dependence of the world upon the staples of centuries past.

During the past century America has been producing an excess of food. She has offered opportunity for development to her own growing population and to the crowded populations of Europe. As long as there was an abundance of rich and fertile land available for cultivation, the major effort of agricultural research has been to increase the production per man and that effort has been so highly successful that one agricultural worker can to-day produce four or five times as much food as his grandfather could. The major portion of the nation's rich and fertile acres has now been taken up. If this nation is to continue to develop for another century, as she has during the past, those engaged in agricultural research must redouble their efforts and increase the production per acre as they have in the past increased the production per man. The European nations reached this condition a long while ago and those nations that recognized the problem and put forth the greatest efforts in the development of food production have grown the most rapidly in wealth and power. The field of agricultural research therefore offers to the coming generation of

scientific workers a wonderful field for individual advancement and, at the same time, outstanding opportunity for national service.

AGRICULTURAL RESEARCH EMBRACES MANY FIELDS

Agriculture is not a single science but the application of many sciences to the agricultural problem. Almost every agricultural problem has a chemical and a biological phase. Many of them involve problems in physics, physiology, bacteriology and genetics. The soil problems lead into geology, while irrigation and drainage have many relations with engineering. The biological sciences have been split into many fields, such as plant pathology, entomology, parasitology, as well as applied subjects such as agronomy, animal husbandry, horticulture, forestry and dairying.

WHO SHOULD UNDERTAKE AGRICULTURAL RESEARCH?

Those who love nature, who take a keen delight in plants and animals, who are interested in life's varied manifestations, who love the great outdoors and outdoor life should be especially interested in agricultural research. In a field as broad as this there is of course every variety of occupation, but in a large majority of the cases those who engage in solving the problems related to agricultural development keep closely in contact with the soil, the plant or the animal and at least a part of their work is of necessity in the open. Research in itself keeps the mind young and growing. Agricultural research affords opportunities that make for health, long life and the physical strength that is required for accomplishment.

The field of agricultural research is so broad that there is opportunity for every one who has a trace of the research spirit. Some position can be found into which one's abilities and capabilities can be fitted. The student, however, who desires to fit himself to reach the highest positions of responsibility, or to make the major contributions to the progress of science, must see to it that his educational foundation has been of the broadest and most fundamental character. Much of the research in the past has been on superficial problems. The great problems of the future are in the solution of fundamentals—problems in most cases involving many of the sciences—and the broader one's foundation in these sciences the more likelihood there is of unlocking nature's secret. Many a man has approached the threshold of a great discovery only to find himself baffled by his lack of training, while some other man with no greater ability but with a broader knowledge of methods of related fields has found the key and unlocked the door of knowledge.

THE QUALIFICATIONS FOR SUCCESS IN RESEARCH

A relatively small number of men and women go to college. A still smaller number should be encouraged to take up research work. Just what the qualities are that make up research ability are hard to define. No examination was ever devised that could determine. Brilliancy in student scholarship is no test. Darwin and Pasteur, two of the greatest research men of the last century, were indifferent students. In other cases, brilliant students have been brilliant research men. Scientific research requires absolute honesty and integrity of purpose. No man should look forward to a career in research who is not fundamentally honest and conscientious. A spirit of public service, of responsibility for the advancement of the nation or the race, is a major asset. A desire to cooperate with your fellows, ability to organize and direct the actions of others, all contribute to success. The vital outstanding factor that makes for success in research is vision, ability to look into the future, to keep an open mind, to hold all information as relative and subject to revision or new interpretation or even to be discarded, if the necessity arises, and an entirely new concept substituted. Vision carried to the extreme becomes visionary. Open-mindedness in the same way becomes skepticism, and yet progress in the research field is conditional upon these attributes of mind. If they be well balanced and coordinated and accompanied by the other essentials there are almost no limits to the possibility of accomplishment. Without them there may be substantial accomplishment—many contributions to the sum total of human knowledge—but the great discoveries will be for others.

ADVANCED TRAINING

With the increasing complexity of all the

sciences the research field is becoming more and more restricted to those who are especially trained for the work. In a complicated subject like agriculture this is especially true. The great advancements of the past have been made by those who have brought the best training to the problem and it is hardly worth while for any one to look forward to that field in the future unless he is willing to undertake adequate training for this service. A statistical study of those who have contributed most to their respective sciences shows that over seventy per cent. of them have earned doctor's degrees. These men represent the education of a generation ago when doctor's degrees were relatively rare as compared with the present time. If this is true to-day, how much greater will the percentage be in the generation to follow!

Three years of advanced training may at the first glance seem formidable. It is, however, relatively easy to obtain under existing conditions. At least one year of graduate work should be taken immediately after graduation. During this year the student will become familiar with the research problem in his major field and have extended his breadth of vision in two or more related lines. The results of this year's work should lead to a final determination as to whether or not he is fitted to enter a research career. If he has been reasonably successful in his major subject it will now be possible for him to obtain employment in the chosen field. That employment should be selected with reference to opportunity offered, rather than salary. A research position in an experiment station or government laboratory, or an assistantship in a scientific department with part time teaching and an opportunity for research, will give opportunity to further try out capabilities and inclinations. Two or three years' work of this kind, making use of every opportunity for acquiring additional training and experience and in demonstrating capabilities along administrative or cooperative lines, are of more value in determining success than are generally realized. Following this, two more years of graduate training under the direction of one of the great leaders in his chosen field should complete the fundamental preparation for his life work. By making use of a scholarship, a fellowship or an assistantship this can be accomplished with relatively small financial outlay. By this time the student will have learned that there is no end to study and development and that every opportunity of obtaining greater breadth of training and especially of making contacts with leaders in the related sciences should be embraced.

OPPORTUNITY FOR SERVICE

Despite the wonderful progress that has been made in the last generation, the opportunity for still further discoveries is unlimited. Every time a problem is solved, three or four new ones are opened up and any worker entering the field will find that there is a crying need for more knowledge on every hand. Who knows that we are using the best breeds of animals that can be developed? For the most part we have been content to continue with those our ancestors used, in many cases without material improvement. It is possible that the introduction of wild strains or the crossing of other domesticated species might easily give us the foundation for the development of still more economical producers than those we are using at present.

In the nutrition field every new investigation, instead of solving our problems, simply opens up further avenues requiring research. The discovery of the existence of vitamins explains why previous nutritional investigations were not conclusive, but the investigation is still to be made that will explain the vitamin.

The plow is one of the most ancient of agricultural implements. It is also one of the most modern. Recent investigations have shown that under certain conditions greater yields have been obtained by omitting the plow. We need to know more about the physics, the chemistry and the biology of plowing. The same is true of tillage in general. The crops of a generation ago have been largely superseded by more productive varieties. Is there any reason to believe that still more profitable forms can not be developed?

Notable progress has been made in bud selection in certain citrus fruits. This same process may be equally valuable over a much wider field of horticulture. The factors of productiveness and hardiness need much careful investigation to determine their causes. The

forestry situation is becoming acute. Our fathers destroyed the forests to get rid of them. Our sons will have to develop anew what their ancestors destroyed. Reforestation involves problems in almost every field of science.

The present methods of control of insect pests have been almost entirely the development of a single generation. The field is as yet hardly touched. Almost every one of our major insect pests needs further investigation. The chemists should combine with the entomologist to study the attractiveness of different grasshopper baits and when they have solved this problem they will find an almost unlimited field in the development of attractive substances to assist in the destruction of injurious insects. The control of plant diseases needs the combination of the chemist, the plant physiologist and the pathologist to work out the intricate problems of the lethal relations of host and parasite. We have been working with a small number of standard insecticides and fungicides. Who knows that modern chemical research does not offer a dozen more efficient compounds than those in present use?

This country has established an enviable reputation for the success of its eradication programs. Contagious pleural-pneumonia, seven outbreaks of the foot-and-mouth disease and many small outbreaks of gipsy moth have been completely eradicated. The citrus canker has been eradicated from the commercial citrus growing regions and is rapidly being eliminated from the remainder of the gulf region. The sweet potato weevil has been greatly restricted in the commercial areas. The Texas fever campaign is approaching completion. The progress of the pink bollworm, the barberry and the tuberculosis eradication programs is very promising. These have been made possible by persistent research that has developed methods. Hog cholera, contagious abortion, the ox warble, the codling moth, the boll weevil and a host of other pests and diseases offer equally favorable opportunity for great national eradication movements as soon as the research workers have perfected the methods that will make them possible.

The discovery of the colloids has opened up a new field of investigation into hundreds of agricultural problems, few of which have as yet been touched. No one can predict the advances possible before this line is exhausted. Our ideas of the plants' sources of nitrogen are being constantly modified. Here is opportunity for exhaustive research. The recent developments in our knowledge of the relation of insects as transmitters of plant diseases and especially the recent discoveries of organisms connected with the mosaics open up a wonderful field of research in which many scientific groups must combine. The influence of meteorological factors on plant and animal development is an almost unworked field. The whole subject of the water requirements of plants, the movement of water in its relation to irrigation and drainage, need much further study. The chemist, the physicist, the biologist and the engineer are all needed in the solution of these problems.

The problems in production have been the major field of agricultural investigation in the past. With the concentration and specialization of populations the problems of marketing and distribution are becoming equally or even more important. The economist must now join forces with the other scientists in the solution of many of the most intricate problems. To further itemize would be superfluous. Every ramification of the field of agriculture offers wonderful opportunity for individual effort, as well as opportunity for contribution to national welfare and human development.

NOT NECESSARY TO GRADUATION IN AGRICULTURE

From the above outline of the problems it is readily seen that a comprehensive research into a complicated agricultural problem requires the services of men trained in many fields of research. The great contributions in most of the applied sciences, such as agriculture, engineering and medicine, have been made by those who have approached the problems through the pure sciences and this will probably be even more noticeable in the future as the superficial problems are solved and the fundamentals are undertaken. There is, therefore, no reason why a graduate who has majored in any of the fundamental sciences should not look forward to a career in agricultural research with every expectation that his chances of success will equal or exceed those who ap-

proach the problem from the standpoint of the more technical agricultural training.

WHAT A RESEARCH CAREER OFFERS

One of the first effects of the World War was to place the scientist and the teacher in an almost hopeless financial condition. One of the secondary effects has, however, been to bring to the attention of the people of all civilized countries the value of science and especially of organized research as an important factor in the preservation of their national unity. The final result promises to be an increased opportunity and recognition for the scientist in general and especially an appreciation of the increased necessity for continued research in the development of any industry.

For the man just out of college or having completed a single year of graduate work, the greatest opportunity will usually be in connection with the educational institution or government bureaus. A few years' experience with its accompanying accomplishment and broadening of vision, combined with educational training, will place the individual in line for further advancement in these organizations or for opportunity to enter the commercial field. With the present trend in salary standards, the research scientist in agricultural lines may look forward to a relatively early opportunity to enjoy a salary that will support his family in reasonable comfort and still allow a margin for accumulation. As he advances in his profession and gains a position of leadership the margin of possible accumulation will increase rapidly. By this time his position will give him social standing and opportunity that others can only purchase by the expenditure of much larger sums of money. In addition, with the growing recognition of the value of the work of scientific men, larger and larger financial rewards are being paid to the best men.

E. D. BALL

DIRECTOR OF SCIENTIFIC WORK
UNITED STATES DEPARTMENT OF AGRICULTURE

THE ART OF MEDICINE

IN the dome of the magnificent structure of contemporary medical education, across the ceiling, are inscribed the words, "Mene, Mene, Tekel, Upharsin."[1] Below, in the alcoves of laboratory science, there may be made out, perhaps less distinctly, the words, which, traced by the Hand, foretold the fall of Babylon: "Thou art weighed in the balance, and art found wanting."

A writer on the medical art, rich in the modern spirit, but not contemporary with us, has said[2] "This is the great error of our day in the treatment of the human body, that physicians separate the soul from the body."

The idea that the patient is a person who is sick, and that the healing art is to make a sick person well, will dominate the medicine of tomorrow, whether the art is applied in time to prevent, or only so late that cure is not possible.

Just now the point of view of psychobiology is becoming recognized as the one from which the physician must regard his patient.[3] How can the student of medicine get this point of view? Best, by example, from his teachers who have it, who treat patients as persons in distress, with dis-ease, seeking the physician for relief. But also, more formally, by a study of the personality as Meyer has indicated.[4]

This point of view involves a reorganization of the medical curriculum. The logic of the present arrangement is clear. It is to study structure, then function, then defective or "diseased" structure and function; and finally, cases of disease, applying the already acquired knowledge of structure and function.

The reorganized curriculum will have a different logic. The patient, a sick person, will be studied first and chiefly. On the hypothesis that function and structure are inter-related, the student will use pre-laboratory methods, and then will go to the laboratory to get help in solving problems which the patient presents. The student will begin with the obvious, or more nearly obvious and go on to the less obvious, or the hidden. He will learn first to use his own senses, then try instruments of greater or less precision.

The course in clinical medicine will be the major course for the four years. It will be the only major course, comprehending surgical therapeutics as well as the other forms of

[1] Daniel, v. 25.

[2] Plato-Charmides, translated by Jowett.

[3] Yerkes, R., "Relation of psychology to medicine," SCIENCE, Vol. liii, No. 1362.

[4] Meyer, A. See Curriculum of School of Medicine, Johns Hopkins University.

FIG. 1. FIRST YEAR

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
9	Lecture	Lecture	Lecture	Lecture	Lecture	Lecture
10	Clinic	Clinic	Clinic	Clinic	Clinic	Path. Lab.
11	Clinic	Clinic	Clinic	Clinic	Clinic	Path. Lab.
12	Clinical Lecture	Clinical Lecture	Clinical Lecture	Clinical Lecture	Clinical Lecture	
1						
2	Lecture	Lecture	Lecture	Lecture	Lecture	
3	Anat. Lab.	Anat. Lab.	Physiol. Lab.	Physiol. Lab.	Path. Lab.	
4	Anat. Lab.	Anat. Lab.	Physiol. Lab.	Physiol. Lab.	Path. Lab.	

therapy now taught as specialties. The laboratory branches will be supplementary, accessory, subsidiary.

This may be set forth in a skeleton schedule (Fig. 1). For convenience in schedule making the laboratory sciences may be put into three groups, the anatomy group, the physiology group and the pathology group. Devoting the morning of five days in the week to clinical exercises, and the afternoon and Saturday morning to laboratory studies, gives six laboratory periods in each week. These may be combined to form three units. The schedule for the first three years, with three groups of studies and three units of time, may be outlined easily.

Five days would be arranged as follows: The first hour (9-10) would be a didactic lecture; the hours from 10 to 12 would be devoted to the study of patients (bed patients, outpatients, patients in the districts); from 12 to 1 there would be a clinical lecture; intermission from 1 to 2; from 2 to 5, laboratory work preceded by as formal a talk as the instructor desired. This would reduce the didactic lectures to two a day at the most, from 9 to 10 and from 2 to 3.

In the second year and in the third year the student would have the same laboratory groups, with the shifting of period as shown in the diagram. (Fig. 2). The fourth year might well be left for electives.

This scheme might be utilized in a complete school of medicine. The course as outlined would be followed by all students for two years. At the beginning of the third year, specialization in dentistry, public health or industrial medicine could be undertaken, and two years, or the second half of the course, might be thus employed. The two years in the clinics with training in the general laboratory branches would be of great value to the dentist or doctor of public health. The "practitioner" would devote four years to clinical medicine.

What about research? There is some confusion of thought here. "Many are called but few are chosen." The capacity for adding to the sum of human knowledge is a rare gift. The capacity for adding to one's own knowledge is possessed by every medical student. So the

FIG. 2.

	First Year	Second Year	Third Year
Anatomy Group	Monday and Tuesday	Wednesday and Thursday	Friday and Saturday
Physiology Group	Wednesday and Thursday	Friday and Saturday	Monday and Tuesday
Pathology Group	Friday and Saturday	Monday and Tuesday	Wednesday and Thursday

spirit of research should be in every student. If he does not have this, medicine is not for him. But let us not think we yet know how to select from the thousands who wish to study medicine each year a few groups of fifty or sixty, for a few schools, so that in each group there shall be even five "righteous" persons, *i. e.*, capable of adding to the sum of human knowledge.[5]

There are many and serious practical objections to the scheme I have indicated in outline, which I shall not take the time to consider now. I have intentionally avoided details. At the risk of being misunderstood, and seeming dogmatic, I have sought brevity. But from many quarters arise suggestions that the student should come in contact with patients earlier than at present. Why not be "simple minded"[6] and begin at the beginning?

STEPHEN RUSHMORE
TUFTS COLLEGE MEDICAL SCHOOL

PRESENTATION OF THE MARY CLARK THOMPSON MEDAL TO DR. EMMANUEL DE MARGERIE

AT the recent meeting of the National Academy of Sciences, the Mary Clark Thompson Medal was presented to Dr. Emmanuel de Margerie by Dr. Charles D. Walcott, president of the academy. In making the presentation Dr. John M. Clarke said:

It should be clearly understood that this award, based upon the foundation established by Mrs. Frederick F. Thompson, has for its purpose the recognition of full achievement in the sciences of geology and paleontology and while the award may encourage its recipient to further endeavor, this is not its first purpose. By the terms of the foundation, the Thompson Gold Medal shall go to him who has not failed in seed time nor in harvest and the fruits of whose labors are evident in the sheaves he has already reaped. This medal has been given but once before and then to Charles D. Walcott, the president of this academy.

Your committee has very cautiously filtered the world of geological achievement in its effort to fix upon the work and the author of the work most fitly to be crowned by this award. It has halted at no national boundaries and its decision has not been a hasty one nor arrived at by any devious crosscut. In consequence the committee has the pleasure of presenting to the academy for the award of this highest honor in these sciences in its gift Dr. Emmanuel de Margerie, former president of the Société Géologique de France, actual director of the geological service of Alsace-Lorraine, the bearer of many distinctions in geology and its allied sciences, laureate of the Académie des Sciences, member of l'Institut and Chevalier de la Legion d'Honneur.

Thirty-five years ago on his return from a visit to France, J. Peter Lesley, a member of this academy, wrote enthusiastically of meeting in Paris, along with Hébert and other men of distinction in science, a young man whom he characterized as "one of the best of the younger geologists—de Margerie." It is quite safe to say to-night that de Margerie still holds title to that characterization subject to some such modification as the best of the younger looking geologists. At all events the thirty-five years have yielded up their harvest and while we respect and honor him for his versatile accomplishments in many fields of investigation, his researches on the dislocations of the earth's crust, on the interpretations of terrestrial relief in terms of earth structure, his extensive and incessant labors on geological cartography, his bathymetric survey of the oceans, his contributions to the geological map of the world, his orogenic studies in the Pyrenees and the Corbières and the Jura—all these are his monuments—but no devotee of this science of geology can fail to recall without emotion de Margerie's most excellent service in translating from exceedingly difficult and intricate German into lucid French and in illuminating this translation with annotations as important as the original work, Suess's "Das Antlitz der Erde," de Margerie's "La Face de la Terre." To this monumental task de Margerie devoted the years from 1894 to 1917. Scrupulously exact in translation, vastly enriching the labors of that master of geological science, de Margerie has given an impulse to the work which

[5] Pritchett, H. S., Report of President of Carnegie Foundation, 1921.

[6] Pearl, Raymond, "Trends of modern biology," SCIENCE, Vol. LVI, No. 1456.

has enabled it to penetrate deep into the present thought of the science. It is a rare good fortune for us that our laureate is here, even though he faces homeward after his cycle of our universities and it is with gratification that your committee introduce him for this award.

After receiving the medal M. de Margerie replied:

My first word in acknowledging the award of the Mary Clark Thompson Medal must be a word of gratitude.

To be selected as a characteristic representative of the trend of geological research at the present time is a very great honor indeed, specially when one recalls the first to receive that signal distinction Dr. C. D. Walcott, our most distinguished president and my friend for many years.

One of the pleasantest days I can recollect in my whole life occurred just four years ago, in 1919, when, as an officer of the Geological Society of France, it became my duty to report on the work of Dr. Walcott, to whom our greatest prize for paleontology and geology, the Gaudry Medal, had been awarded. I felt even more delighted than I could tell to embrace that unique opportunity of summarizing, for the benefit of my colleagues, the splendid contribution to early Paleozoic structural and organic history which have made the name of the present secretary of the Smithsonian Institution famous throughout the world.

How unworthy do I feel when I see on the rolls of the academy my own name following the name of that great investigator, whose services in deciphering the most complicated problems of Cambrian stratigraphy stand in such preeminence—not to speak of so many other achievements, both scientific and administrative, made in the successive capacities of field explorer, of museum curator, of executive officer, and above all, of invertebrate paleontologist!

It is, I believe, the practice on such occasions as this to say a few words regarding one's own personal experience. Autobiography is a very dangerous type of literature, particularly in its oral, improvised form; and I shall not dwell upon the external events of my life, which —just as for happy nations—have been few and unimportant. Allow me only to refer briefly to some incidents in my intellectual history, which are closely connected with the results for which I am standing here to-night.

First among my feelings comes the joy of work and of discovery. The stimulus of getting at something new, even in a very restricted field, of penetrating a little deeper in the knowledge of nature, has always appeared to me as one of the reasons of living and one of the justifications of effort.

But the true, perhaps, would seem unattractive if it were not constantly associated with the beautiful. And is not the geologist specially fortunate in deciphering, as in a laboratory of his own, sea-cliffs and canyons, great mountain-ranges and glacier-sculptured peaks, burning volcanos or silent caverns? To my mind science seems as inseparable from art; think only of Leonardo, or, nearer to us, of Ruskin, and again, in our own days, of that man of genius, but so modest that very few know of him, William Henry Holmes!

Another factor in science, the importance of which I would like specially to emphasize, is the element of sympathy—the moral or social element. Every bit of scientific work is the product of human effort, the final outcome of a far-reaching chain of inheritance, combined with some data of personal discovery; it occupies a definite place in the intellectual evolution of mankind—and there lies the reason why the history of science, so ably advocated in this country by Dr. Sarton and more particularly on its geological side by Dr. Merrill, is of such importance to develop a deeper comprehension of the past and a surer construction of the future.

Now, to speak again of myself, I have to admit that anything of value which may have come from my pen, in geology and geography, was largely obtained through association with one friend or another. The two first volumes on which my name appeared in print and which were both published in 1888—*Les Dislocations de l'Ecorce terrestre* and *Les Formes du Terrain*—were written in conjunction with my revered masters, Professor Albert Heim, of Zürich, and General de La Noë, of Paris. And, in the preparation of the work which has ab-

sorbed more than half of my time since I became interested in geology—the French edition of Eduard Suess's masterpiece: "The Face of the Earth"—I enjoyed the efficient help of twelve among the most active of French geologists and geographers.

Finally, when I was obliged to act alone, may I state that I have always had before my eyes the desire to do full justice to my predecessors in the very field where I was working? The perhaps too bulky volume on the "Structure of the Jura Mountains," which has just been published by the Geological Survey of France, and which is only the introduction to a monograph of a more original character, is, in fact, a continuous appeal to the rights of writers of past generations to get our full esteem for what they achieved, often under very unfavorable circumstances.

I fear I have expanded perhaps too much on my own psychology; and, still, I feel compelled to add something more: the great inspiration I have found, since more than forty years, in perusing the magnificent documents with which America has enriched, during that time, geological science in all its various branches. Never shall I forget the deep impression which some of your great men made upon my youthful mind when I first met them in Paris in the year 1878, on the occasion of the inaugural meeting of the International Congress of Geologists. Again, in 1891, at the fifth session of the same body, what a joy it was for me to greet so many eminent teachers and to exchange ideas with such men as James Hall, Dana, Emmons, Gilbert, King, Lesley, Newberry, Powell, Shaler, Whitney, the two Williamses and many others who, alas, have now passed away, but who have still left to us here the benefit of their wide learning!

To conclude, let me tell you how proud I feel to have received as an acknowledgement of my life-work this beautiful medal; let me thank you for your generosity which I am sure, will be felt very deeply by my colleagues in the French Academy and by French scientists at large; and—last, but not least—let me express my very cordial gratitude and affection to Dr. Clarke for his kind and sympathetic appreciation of my humble efforts.

SCIENTIFIC EVENTS

EDWARD WILLIAMS MORLEY

THE following resolutions were passed at the New Haven meeting of the American Chemical Society in memory of Edward Williams Morley, an honorary member of the society:

The American Chemical Society in this memorial wishes to express its appreciation of the great loss it has sustained by the death of Professor Edward W. Morley, who was to have been the honorary chairman of this meeting.

Born in 1838, graduated from Williams College in 1860, he entered the Congregational ministry and was called from it to be professor of natural history and chemistry in Western Reserve College in 1869. He was actively connected with this institution for 37 years and since his retirement has made his home near Hartford, Connecticut, in which city he died on February 24 of this year, shortly after his eighty-fifth birthday.

Although Western Reserve College was but little known at that time, Professor Morley soon brought it into prominence and raised himself by his own genius to be one of the foremost scientists of his time. He was as much a physicist as a chemist, and most of his published papers, curiously enough, lie in the domain of physics, although he allied himself primarily with the chemists.

With remarkable characteristics for precision and thoroughness, he possessed also an unusually clear and resourceful mind and a wonderful mechanical skill, so that he was not only a great investigator, but also an inventor of many new devices for fine and exact measurement. Among these were a precision eudiometer for the rapid determination of oxygen, two types of differential manometers, by which differences of gaseous pressure can be measured to the 1/10000 mm. of mercury and many mechanical features of a minor sort used in the manipulation of gases. Together with Professor Michelson he developed the interferometer, an apparatus for measuring lengths in terms of the wave-length of light, and employed it in measuring the expansion of metals, the relative motion of the earth and the ether, and the velocity of light in a magnetic field.

The work, however, for which he is best known among chemists is that on the densities of oxygen and hydrogen and the ratio in which they combine, published as Smithsonian Contribution to Knowledge, No. 980. This research, finished in 1895 and on which he was engaged for eleven

years, brought him world-wide recognition as a scientist of the first rank.

Professor Morley was of a very modest and retiring nature, never pushing himself forward, and for this reason he was not known intimately to many. But those few who enjoyed the privilege of knowing him well were impressed by the sweetness of his nature, the broadness of his culture and knowledge, the nobleness of his spirit and the wisdom of his counsel.

By making him its president in 1899 and electing him to honorary membership in 1900 this society honored not so much him as itself.

REGISTRATION IN GERMAN UNIVERSITIES

FOREIGN exchanges publish particulars as to the number of students in German universities. The total number had increased to 60,000 at the outbreak of war. At the end of the war the number was 90,000, and in the summer of 1921 it was 87,147. At present it is 82,668. The Technischen Hochschulen had 12,000 students before the war, in 1920 they had 22,976, and last winter 25,556. The division into faculties has undergone changes; the warnings of overcrowding in some faculties have had some effect, but the stream of students has been diverted into other faculties, which are also now hopelessly overcrowded. The following comparison is given with pre-war conditions:

Faculty	1914	1922
Evangelical theology	4,370	2,974
Catholic theology	2,050	1,795
Legal science	9,840	16,834
Medicine	16,048	15,110
Dentistry	976	4,167
Philosophy and philology	14,400	12,823
Mathematics and natural sciences	8,132	9,257
Pharmacy	1,100	1,112
National economy	3,836	17,714
Forestry	.....	490

The following refer to technical students:

Faculty	1914	1922
Architecture	2,193	1,811
Constructional engineering	2,767	3,311
Mechanical engineering	3,118	8,306
Electrotechnics	1,307	5,129
Mathematics and natural sciences	1,544	3,735
Mining and metallurgy	576	1,234
Naval engineering	234	365
General	493	1,483

It is stated that the present day student does not tend to the same extent as before the war to study in the large cities.

THE KENTUCKY ACADEMY OF SCIENCE

DR. WILLARD ROUSE JILLSON, director and state geologist of the Kentucky Geological Survey, was elected president of the Kentucky Academy of Science at its tenth annual meeting, which was held at the University of Kentucky on May 12. Dr. Austin R. Middleton, of the University of Louisville, was elected vice-president; Dr. Alfred M. Peter, of the Kentucky Agricultural Experiment Station, secretary, and Professor W. S. Anderson, of the University of Kentucky, treasurer.

The academy voted the authority to its president to make arrangements for the publication of its transactions, which up to the present have never been printed. It also voted to sustain the recent resolutions of the council of the American Association for the Advancement of Science with respect to the facts of organic evolution and the freedom of teaching it and science generally in the public schools. Resolutions covering these points were drafted and approved, and have been forwarded to the secretary of the American Association for the Advancement of Science.

Dr. Jillson outlined a proposed symposium on "Evolution" to be presented during the year as an educational feature under the auspices of the Kentucky Academy of Science in the city of Louisville, and this proposal was heartily endorsed by a unanimous vote. Preparations are now under way for this special meeting, which will be open to the public, and will be held in Louisville probably during the spring of 1924. The regular meeting of the Kentucky Academy of Science for the presentation of scientific papers and the transaction of business will be held at about the usual time in Lexington.

APPOINTMENTS AT THE BUREAU OF MINES

DURING the absence in Europe of George S. Rice, chief mining engineer of the Bureau of Mines, and until further notice, James W. Paul will be acting chief mining engineer, with headquarters at Washington.

C. A. Herbert is detailed to Pittsburgh to serve as acting chief coal mining engineer, beginning on June 1 for a period of five months, and will report through the superintendent of the Pittsburgh Station to Mr. Paul. He will have immediate charge of the experimental

mine work and other coal-mining investigations, except the coal waste inquiry for the United States Coal Commission, which work will be handled directly by Mr. Paul.

M. van Sielen, assistant to the chief mining engineer, will continue in that position and act as executive officer for the mining division, consulting on technical matters with the acting chief mining engineer. He will also act in the capacity of district mining supervisor in leasing matters, except petroleum on Indian lands, and will maintain contact with the commissioner on Indian affairs on all Indian mineral leasing matters, consulting with H. I. Smith on coal-leasing technical matters.

H. I. Smith will continue as mining supervisor and will report through the assistant to the chief mining engineer on administrative matters, consulting with the acting chief mining engineer on technical matters.

S. P. Howell, after July 1, will be detailed to the field investigation of liquid oxygen explosives under the new appropriation. J. E. Crawshaw will continue to serve as acting head of the explosives section and report through the superintendent of the Pittsburgh Station to the office of the chief mining engineer.

FOREIGN MEMBERS OF THE WASHINGTON ACADEMY OF SCIENCES

THE board of managers of the Washington Academy of Sciences has elected the following scientific men to honorary foreign membership in recognition of their prominence in their respective fields and their intimate connection with scientific work in Washington:

Professor Leon Manouvrier, Ecole d'Anthropologie, Paris, in recognition of his life-long work in anthropology.

Dr. Carl Frederik Albert Christensen, director of Universitets Botaniske Museum, Copenhagen, in recognition of his services to systematic botany, particularly his monographic studies of tropical American ferns.

Dr. Paul Marchal, Ministry of Agriculture of France, in recognition of his investigations in biological problems and their relation to agriculture, especially for work in polyembryony.

Mr. Edward Clayton Andrews, government geologist of New South Wales, in recognition of his work in geology, particularly in the fields of origin of coral reefs, physiography, origin of the Australian flora, mountain formation and origin of metalliferous deposits.

Sir Ernest Rutherford, director of the Cavendish Laboratory, University of Cambridge, in recognition of his work in physics.

F. Omori, professor of seismology, University of Tokyo, in recognition of his work in the field of seismology.

Professor Guiseppi Stefanini, Instituto di Studi Superiori, Pizza San Marco, Florence, in recognition of his investigations in paleontology and stratigraphy, especially the tertiary formations of Italy and echinoids in general.

Professor Max Weber, University of Amsterdam, in recognition of his work in zoology.

SCIENTIFIC NOTES AND NEWS

ARTHUR GORDON WEBSTER, since 1892 professor of physics in Clark University, died by suicide on May 15, at the age of fifty-nine years.

MR. ALVA JOHNSTON has received the $1,000 Pulitzer prize of the School of Journalism of Columbia University for the best example of a reporter's work during the year for his reports of the meeting of the American Association for the Advancement of Science, published in the New York *Times* from December 27 to 30.

DR. FREDERICK P. GAY, professor of bacteriology in the University of California and at present chairman of the Division of Medical Sciences of the National Research Council, has received from the Belgian Ambassador, on behalf of King Albert, the decoration of Commander of the Order of the Crown in recognition of his scientific work.

DR. EMMANUEL DE MARGERIE, French exchange professor to the United States, was given a farewell luncheon by the American engineering profession at the Harvard Club on May 18, at which several hundred engineers were present. Dr. Albert R. Ledoux, past president of the American Institute of Mining and Metallurgical Engineers, presided.

AT the annual meeting of the Association of American Physicians at Atlantic City, N. J., May 1-3, the following officers were elected: *President,* Dr. Charles F. Martin, Montreal; *vice-president,* Dr. Lewis A. Conner, New York; *secretary,* Dr. Thomas McCrae, Philadelphia, and *treasurer,* Dr. Joseph A. Capps, Chicago.

AT the annual congress of the Ophthalmological Society of the United Kingdom, held

in London at the headquarters of the Royal Society of Medicine, April 26 to 28, Dr. George E. de Schweinitz, president of the American Medical Association, delivered the Bowman Lecture on "Certain ocular aspects of pituitary body disorders." Dr. de Schweinitz was elected an honorary member of the society.

PROFESSOR ARTHUR H. BLANCHARD, head of the highway engineering department of the University of Michigan, was re-elected president of the National Highway Traffic Association at the final session of the annual convention on May 10.

DR. FREDERICK F. RUSSELL, formerly director of the International Health Board's public health laboratory service, has been appointed general director of the International Health Board to succeed Dr. Wickliffe Rose, who resigned to accept the presidency of the newly incorporated International Education Board, and of the General Education Board. The latter office became vacant by the retirement of Dr. Wallace Buttrick, who became chairman of the General Education Board.

DR. LEWIS W. HACKETT, associate regional director of the International Health Board, Rockefeller Foundation, has been transferred from Brazil to Italy, with headquarters in Rome. He will sail for Europe in December.

DR. AUGUST HUND has been appointed electrical engineer in the radio section of the Bureau of Standards. He is a graduate of the Technische . Hochschule, Karlsruhe, and has been working in the graduate department of the University of California.

MERRILL A. YOUTZ, formerly of the Research Laboratory of Applied Chemistry, Massachusetts Institute of Technology, Cambridge, Mass., has accepted a position in the research laboratory of the Standard Oil Co., Whiting, Ind.

G. F. MOULTON has resigned his position at the Bureau of Standards to accept a place as chemist in the research department of F. C. Huyck & Sons, Albany, N. Y.

DR. PAUL M. GIESY has been made director of the Brooklyn Research Laboratories of E. R. Squibb and Sons, manufacturers of chemicals and medicinal products.

THE Biological Survey of the United States Department of Agriculture has arranged with the Navy Department for transportation for a party of scientific men who will make a general survey during the spring and summer of the plant and animal life of the chain of islands extending from Niihau in the Hawaiian group to Midway and Wake. Dr. Alexander Wetmore, of the Biological Survey, will have general direction of the scientific activities of the expedition, which will be carried on in part by members of the staff of the Bishop Museum, Honolulu. Donald R. Dickey of Pasadena will accompany the party to secure moving pictures of the colonies of sea birds on Laysan Island.

DR. ELLINOR H. BEHRE, assistant professor of zoology at the Louisiana State University, has returned from a three months' trip across the northern end of Panama. She devoted herself largely to the study of fishes, collecting live specimens of the poecilidaes for breeding experiments and a series of specimens to indicate the nature of the fauna.

DR. JOHN W. HARSHBERGER, of the botanical department of the University of Pennsylvania, will sail for Europe early in June to carry on research work in botany. He will join the International Phytogeographic Excursion through the Swiss Alps in July and August.

DR. A. S. HITCHCOCK, accompanied by his wife, left in May for South America, where he will make botanical collections. Three months will be spent in Ecuador, the work being a continuation of the cooperation between the United States Department of Agriculture, the Gray Herbarium and the New York Botanical Garden in studying the botany of northern South America. About three months will be spent in Peru and Bolivia studying grasses for the Department of Agriculture.

DR. E. P. FELT, New York state entomologist, has been given a year's leave of absence for special work for the State Conservation Commission in connection with the campaign against the European corn borer.

PROFESSOR HORACE G. BYERS, head of the Department of Chemistry, Cooper Union, and president of The American Institute of Chemistry, sailed May 8 for a three to four months'

trip to Belgium, Germany and France. The greater part of Dr. Byers's time will be spent on investigating the status of the chemical industry in Belgium and France.

DR. FREDERICK L. HOFFMAN, consulting statistician of the Prudential Insurance Company, expects to participate in the meetings of the American Medical Association and the efforts which are being made by the American Society for the Control of Cancer to arouse more public interest in the question of cancer control on the Pacific Coast. Dr. Hoffman on his return will revisit the Navaho and Zuni Reservations of New Mexico and Arizona to continue his investigations which include the measurement of some 1,600 Indians and mixed bloods.

THE May meetings of the University of Pennsylvania Chapter of Sigma Xi was held on the sixteenth of the month at The Wistar Institute of Anatomy and Biology. Professor H. H. Donaldson outlined the work of the institute; Professor Helen D. King spoke on "Domestication," and Professor F. S. Hammett on "Sensitivity and adaptability of the albino rat."

DR. EDWARD L. NICHOLS, professor emeritus of physics in Cornell University, lectured before the Sigma Xi Club and the Scientific Society of West Virginia University on May 10. His subject was "Incandescent oxides."

THE Pennsylvania State College Branch of the American Association for the Advancement of Science held a dinner meeting at the University Club on May 24. Following the dinner Dr. Herman L. Fairchild, emeritus professor of geology at the University of Rochester, spoke on the subject "Glacial history of the Susquehanna Valley."

DR. S. J. HOLMES, professor of zoology in the University of California, gave the annual Phi Beta Kappa address before the California Chapter on May 15.

PROFESSOR T. WINGATE TODD, of Western Reserve University, delivered on April 28 an address before The Royal Canadian Institute on "Royal mummies."

DR. R. M. WILSON, superintendent of the Kwangjer Leper Hospital, Korea, spoke at Washington University School of Medicine on May 9 on the development of the hospital from a few mud huts to its present well-equipped and organized state. Practically all this work has been done by the leper patients. Dr. Wilson has been treating the lepers with Chaulmoogra Oil, recently discovered to be of benefit in this condition. He reports that he has been able to discharge a considerable number of patients as cured, and many others have been greatly benefitted.

A TABLET to Alexander Wilson, American ornithologist, was unveiled at the Academy of Natural Sciences, Philadelphia, May 17. It was designed by Dr. R. Tait McKenzie and presented to the academy by the St. Andrews Society of Philadelphia, through the generosity of the late Dr. F. Lawson Cameron. Alexander Wilson was born in Paisley, Scotland, July 6, 1766, and died in Philadelphia, August 23, 1813.

LOUIS DERR, professor of physics at the Massachusetts Institute of Technology, has died in Boston at the age of fifty-one years.

THE Ohio State Archeological Museum has been made the recipient of the entire collection of Dr. G. Frederick Wright, glacial geologist, which has been gathered from all parts of the world. Dr. Wright was president of the Ohio Archeological and Historical Society for 10 years and president emeritus for two years until his death, in 1921.

THE Steward Observatory of the University of Arizona was dedicated on April 23 on the day of the inauguration of Dr. C. F. Marvin as president of the university. The program included addresses by Dr. Vesto Melvin Slipher, director of the Lowell Observatory; Dr. Robert Grant Aitken, of the Lick Observatory, and Dr. Andrew Elliott Douglass, director of the Steward Observatory.

THE results of the efforts to raise $250,000 among the members of the New York Academy of Medicine for the purchase of a site for a new building were announced by Dr. George David Stewart at the stated meeting of the Academy on May 3. The total amount subscribed up to that time by fellows and associate members was $317,711. The total percentage of resident active fellows subscribing

is 90 per cent., the total percentage of all classes of members who have contributed is 82 per cent. The success of the academy in securing this fund assures it of the contingent fund of $1,000,000 from the Rockefeller Foundation and a similar amount from the Carnegie Foundation for the building and for endowment.

THE Astronomer Royal of Great Britain, Sir Frank Watson Dyson, has informed the Harvard College Observatory by cablegram of the discovery of a nova, or new star, on May 8 by Anderson. The initials of the discoverer are not given in the cablegram, but it is presumed that he is the Rev. T. D. Anderson, an English clergyman and amateur astronomer. The new star was situated in the constellation Cygnus, and was of the fifth magnitude, or in other words just about bright enough to be seen with the naked eye under very favorable conditions. The cablegram was relayed to Harvard by the Bureau of Astronomical Telegrams at Copenhagen, Denmark.

THE attention of entomologists throughout the world is called to the fact that, beginning with the volume for 1922, the preparation of the "Insecta" part of the *Zoological Record* is being undertaken by the Imperial Bureau of Entomology. In order that the *Record* may be as complete as it is possible to make it, all authors of entomological papers, especially of systematic ones, are requested to send separata of their papers to the bureau. These are particularly desired in cases where the original journal is one that is not primarily devoted to entomology. All separata should be addressed to the assistant director, Imperial Bureau of Entomology, 41 Queen's Gate, London, S. W. 7, England.

THE secretary of the General Post Office of Great Britain announces that for the purpose of carrying out the scheme by which, in conjunction with the Air Ministry, daily weather reports are to be distributed all over the country by means of the telephone exchanges, England, Scotland and Wales have been divided into some forty districts. Each exchange will thus have available for subscribers information that will be appropriate to the area in which the exchange is situated. It will only be necessary for telephone subscribers to ring up the operator at the local exchange at or after 5 p. m. to obtain the forecast for the following day. No charge will be made beyond the local call fee, and in the case of rural party lines subscribers no fee is payable. The forecast may be obtained also by ringing up from public call offices upon payment of the ordinary local call office fee.

STATISTICS published in the *Journal Officiel* show that the number of births in France in 1922 was 759,846 and the number of deaths 689,267, being an excess of births over deaths of 70,579. The excess of births in 1921 was 117,023 and in 1920 159,790, but the figures for the last year compare favorably with those of 1913, when the number of births was 790,355 and the number of deaths 731,441, being an excess of births over deaths of only 58,914. The number of marriages in 1922 was 383,220, against 456,221 in 1921, 623,869 in 1920, and 312,036 in 1913.

THE Royal Academy of Sciences of Amsterdam has recently prepared a series of papers (in English) summarizing the development of various fields of science in the East Indies, one of which is "A review of chemical investigations in the Dutch East Indies." This is a brief and comprehensive digest of the contributions which have been made by Dutch chemists of the East Indies upon problems of pharmaceutical, agricultural and industrial chemistry of that region. Special mention is made of cinchona cultivation, the sugar industry, rubber, tea, coffee and tobacco cultivation, the production of essential oils and phytochemical investigations. A supply of these papers has been sent to the National Research Council. Copies may be obtained (without charge) by addressing Dr. E. W. Washburn, chairman, Division of Chemistry and Chemical Technology, National Research Council, 1,701 Massachusetts Avenue, Washington, D. C.

ADDITIONS have been made to the zoological museums of the University of Iowa through the courtesy of two alumni, Alfred H. Bailey, curator of birds and mammals in the Colorado Museum of Natural History, Denver, Col., and Clarence J. Albrecht, curator of zoological exhibits at the University of Washington. Numerous birds and some animal skins comprise the new collections which were presented first

to Professor Homer R. Dill, director of the vertebrate museum at the University of Iowa, who in turn presented them to the university.

THE British Medical Research Council has undertaken to organize an investigation into dogs' distemper, towards which funds will be provided by the *Field* Distemper Council. Researches will be conducted by members of the Medical Research Council's staff, partly at the National Institute for Medical Research, Hampstead, but more particularly at the new farm laboratory, for which a site near London has recently been acquired. As opportunities arise and suitable assistance can be secured, inquiries coordinated with these will be promoted at other centers of work. These investigations will also be brought into relation with other studies in human and animal pathology. The Medical Research Council has appointed the following scientific committee to advise on the subject and to direct the investigations: Sir William B. Leishman, K.C.M.G., C.B., F.R.S., director of pathology, War Office, and a member of the Medical Research Council (chairman); Mr. J. B. Buxton; Captain S. R. Douglas, F.R.S., National Institute for Medical Research; Professor F. Hobday, and Dr. C. J. Martin, F.R.S., director of the Lister Institute.

IT is reported that the appropriation bill for the Pennsylvania State College covering the years 1924 and 1925 now before the Pennsylvania legislature allows only $1,360,000 for general college operation, a sum over half a million below what is now required for maintenance. It is said that the college can not stand this cut and perform the work it is now doing. In part, a reduction on this scale would mean that: There would have to be a thirty per cent. reduction in a student body of 3,300 men and women; practically no new students could be admitted for two years; the college would face a possible disruption of organization through the loss of valued faculty members; no new research demanded by the people of the commonwealth could be undertaken and present investigations might have to be abandoned entirely; no expansion of work could be considered. Farmers have but recently asked for a new department of agricultural economics at State College, but this could not be established with the maintenance figure proposed.

UNIVERSITY AND EDUCATIONAL NOTES

THE State Legislature of Kansas has appropriated $2,215,288, exclusive of the Smith-Lever offset funds, for the support of the college and station during the biennium beginning July 1. This amount is about $500,000 less than the appropriation made in 1921, the reduction resulting chiefly from the diminished requests by the college for new buildings. The appropriations for salaries and maintenance, from which most of the state funds for the support of the main station are allotted, were slightly increased. The funds for the four substations were increased from $66,000 to $95,288.

A COMPETITIVE scholarship of $1,000 has been offered by the Harvard Engineering School for the year 1923-24, to be open to seniors graduating next month from colleges or departments of liberal arts throughout the country. No student now in Harvard will be eligible for the competitions nor any student registered in any engineering or technical school. Award of the scholarship will be based on the complete academic record of the applicant, together with the result of a special three-hour written examination including mathematics and physics.

DR. LEONARD B. LOEB has been appointed assistant professor of physics in the University of California. Dr. Loeb was assistant to Sir Ernest Rutherford in the University of Manchester in 1919, and for the past four years has been national research fellow in physics. During that period he has worked at the University of Chicago and has published a number of papers on ionization in gases.

AT Harvard University Dr. Esper S. Larsen, Jr., of the U. S. Geological Survey, has been appointed professor of petrography to fill the vacancy caused by the retirement of Professor John Eliot Wolff. Dr. Kirtley Fletcher Mather, now head of the geological department of Denison University, Granville, Ohio, has been appointed professor of geology for

a term of one year. Dr. John H. Mueller, now associate professor at Columbia University, has been appointed assistant professor of bacteriology and immunology in the medical school. Dr. E. L. Chaffee has been promoted from an assistant professorship in the department of physics to an associate professorship. Dr. Hilding Berglund, research assistant, has been appointed assistant professor of medicine.

DR. OSCAR M. SLOSS has resigned his post at the Children's Hospital, Boston, to become professor of pediatrics in the Cornell University Medical School.

DUE to the continued illness of President Samuel F. Kerfoot, of Hamline University, Dean Henry L. Osborn, professor of biology and geology, has been authorized to assume the responsibilities of president in his absence.

DISCUSSION AND CORRESPONDENCE

THE ENDOWMENT OF SCIENTIFIC RESEARCH

SCIENCE for April 13 contains two timely reflections upon the use of wealth to aid research. One of them laments the taking over of the research functions of the university by wealthy corporations; the other, echoing Dr. Pritchett's pessimistic query—Can wealth be given away to the benefit of the public?—raises a doubt as to the efficacy of large benefactions in aid of scientific research.

If corporate capital is robbing our universities of their best research professors, should not the fact constitute a stimulus for increasing the diminishing supply rather than a cause for deploring the increasing demand? And if it is lamented that great benefactions to scientific research as now administered do not produce the results one would rightly expect, is not that a reason for changing the prevailing modes of administering these great trusts, rather than a ground for discouraging them altogether?

It is idle to maintain that great corporations can exhaust the most interesting fields of modern science; for every new scientific discovery opens up a dozen new problems of scientific research. Moreover, the fact that these corporations with their great capital of wealth and inventive brains are every day providing science with improved tools for research that university resources could never hope to supply is constantly ignored in these Jeremiads.

It is equally idle to maintain that benefactions in the aid of science are in themselves and *per se* fatal to scientific progress. For these benefactions are supposed to be gifts to science, not gifts to persons. If science does not derive benefit from them, it argues that there is something wrong with the method by which they are administered, not with the gifts themselves.

That the prevailing mode of administering great benefactions in the aid of science is not as efficient as it might be may be due to the fact that those who determine the personal recipients of these funds and the particular research problems to which they shall be applied must decide these matters largely from a personal rather than from a scientific point of view. I do not mean to charge favoritism—that this "kissing goes by favor": but no dozen men in the world, scientists or business men, are capable of wisely determining in all cases and under all circumstances the most fruitful application of these great benefactions. If the proposed benefaction is to be limited to some field of research, its application should be determined by the consensus of the majority of the most experienced research scientists in that field, and not upon the special predilections and enthusiasms of one or two of them; if it is to cover the whole field of scientific research it should first be impartially budgeted with regard to the needs of each particular field and then applied in accordance with the consensus of the majority of its most experienced representatives.

We now have special American organizations for research in the cardinal branches of science and a general clearing house for activities of American scientific research as a whole. By using these instrumentalities to determine the application of benefactions to scientific problems we should at least escape from the limitations of small groups of scientific almoners. Even though the results might not prove to be all that could be desired, the plan is well worth trying, especially in view of the fact that it seems already to have worked well on a small scale. Such a plan would at least prevent the

frittering away of large resources upon schemes of research that are unwisely planned or prematurely undertaken or imperfectly coordinated with other activities of advancing science. And if it failed it would at least put the responsibility of justifying these expenditures of wealth, where it really belongs, upon American science as a whole.

With such a scheme of apportioning benefactions in the aid of pure science, the commercial utilities of research might safely be left to take care of themselves; for the large majority of the members of our scientific associations are themselves college professors, and would know well enough what scientific problems needed the support of benefaction and what could be wisely left for solution to the selfish interests of commercial organizations.

MARK H. LIDDELL
PURDUE UNIVERSITY

A TEST FOR ECLIPSE PLATES

THE mere fact that photographs taken during a total solar eclipse show a bending of light rays does not, of itself, prove the Einstein theory. Such bending may be due to the Einstein effect, or may be due to one of several perfectly natural causes: refraction of light through the masses of matter surrounding the sun, or abnormal refractions in the atmosphere of the earth. Until the possible effects of these natural causes have been completely eliminated, the observed light deflections during an eclipse cannot be taken as proof of relativity.

The effects of abnormal refraction in the earth's atmosphere may be very similar in character to the so-called Einstein effect. The higher the sun in the heavens at the time of the eclipse, the more nearly will the effects of abnormal refraction approach the Einstein effect. In fact, in the ideal case the two effects (abnormal refraction and Einstein) follow practically the same law. If, at the time of the eclipse, the sun be in the zenith of the observer and the atmosphere be perfectly quiet, then the shadow of the moon would cause a funnel of cool air to form, coolest along the vertical axis of the shadow. A ray of light from a star would, therefore, pass from warmer air to the cooler air of the shadow axis in reaching the photographic plate, and such ray would be refracted, or would show a bending; and the amount of such refraction would depend upon the distance of the star from the axis of the shadow. The law by which the amount of such refraction would decrease with the distance of the star from the center of the shadow would be the same as that for the so-called Einstein effect. A difference in temperature of only a very few degrees between the air at the axis of the shadow and that at the edges would cause a bending of the rays fully as large as that called for by Einstein. This abnormal effect might be larger than and completely mask the ordinary refraction.

There is rather a simple way of testing an eclipse plate for the presence of such abnormal refraction. Such a plate shows not only the images of the stars, but also the image of the moon. Various points on the edge of the moon might be measured in identically the same way as the star images. Such moon measures could be reduced in a manner entirely similar to that used for the stars, applying the same corrections for orientation, scale value, differential refraction, etc. From these measures could thus be obtained the values for various diameters of the moon and such measured diameters could be compared with that calculated from the lunar tables.

Such an operation ought to give a very good check on other measurements on the plates, it ought to show up any plate distortions, instrumental errors or atmospheric abnormal refractions. If the various diameters of the moon, so measured, show no distortion and agree with the calculated value, then this check would be fairly conclusive evidence that any star deflections obtained are caused by some cosmic action, are due to some cause or causes at a distance farther from the earth than the moon. On the other hand, if the moon diameters show distortions, or a value different from the calculated value, it would be good evidence that any other observed deflections are also of terrestrial origin, either instrumental or atmospheric.

On a plate of very long exposure the motion of the moon during the interval might cause complications, but on a plate exposed for only a few seconds such motion ought to be negligible.

Unless this, or a similar test can be made, the possibility that the observed bending of the light rays from the stars may be due to ter-

restrial causes will always remain, and the eclipse plates, whatever their results, can not be cited as proof of the Einstein theory.

CHAS. LANE POOR

DECEMBER, 1922

CHANGE OF FREQUENCY ON SCATTERING

A. H. COMPTON in a lately received bulletin of the National Research Council has reported some recent results obtained by him showing an increase in wave length of X-rays on scattering by graphite of the Molybdenum Kα line amounting to .022Å. U. A. Sommerfeld in his recent lectures, and Compton in *Phys. Rev.*, February, 1923, page 207, have shown that from the quantum theory the shift should be independent of the wave length of the primary beam and of magnitude $\Delta\lambda = \frac{2h}{mc} \sin^2 \frac{\theta}{2}$ where θ is the angle between the incident and scattered beam, h is Planck's constant, m the mass of an electron and c the velocity of light. At $\theta = 90°$ the value of $\Delta\lambda$ is .0242 Å.U $= \frac{h}{mc}$. Compton states that according to his "absorption measurements, over the range of primary rays from .7 to .025 Å.U. the wave length of the secondary X-rays at 90° with the incident beam is roughly .03 Å.U. greater than that of the primary beam which excites it."

Such a shift, if it exists in visible light, should be detectable by interference methods. The writer has looked for such a shift with negative results. A Lummer-Gehrcke plate of resolving power 360,000 was used and the scattered beam compared with the direct beam using the green mercury line as well as various helium lines. The scattering substance was a block of paraffin and scattering was observed at nearly 180°, so that the shift should have been about .048 Å.U., while the plate should resolve to .015 Å.

Multiple reflections to the number of 16 at nearly 180° between silvered glass surfaces were also tried. All results were negative.

P. A. Ross

STANFORD UNIVERSITY

WHAT IS A PLANT?

THE discussions which have appeared in SCIENCE during the past weeks indicate that botanists are unable to agree as to a definition for a plant. In such a situation a chemist may perhaps be pardoned for offering a suggestion. The presence or absence of chlorophyll is obviously no criterion, for certain plants, *e.g.*, the "Indian pipe," *Monotropa uniflora*, are devoid of pigments. There is, however, one essential *chemical* difference between plants and animals. In *animals* the principal structural material is *protein* or some form of protein, whereas in plants *carbohydrates* predominate. Could not one, therefore, define a plant as "*a living organism whose cell walls consist predominately of carbohydrate materials?*" This would include the bacteria whose cell walls are composed of chitin, a nitrogenous carbohydrate. The fact that chitin forms the shell structure of certain invertebrates, such as the lobster, does not invalidate the definition, for the cell walls of such animals are composed predominately of protein.

R. A. GORTNER

UNIVERSITY OF MINNESOTA

SCIENTIFIC BOOKS

The Anatomy and Physiology of Capillaries, The Silliman Lectures for 1922 at Yale University, by AUGUST KROGH, Ph.D., LL.D., Professor of Zoo-Physiology, Copenhagen University. Yale University Press, 1922.

IN the circulation of the blood "the organs of propulsion, distribution and carrying back are all subservient to the function of exchange carried out in the capillaries and though, of course, each of the great organs is absolutely necessary for the functioning of the whole, it will be difficult to challenge the proposition that the capillaries constitute the most essential part of the whole circulatory system." Thus Professor Krogh early in the first lecture of this series emphasizes the broad importance of his topic. It is a conception which looks upon the particular topic, not as an isolated phenomenon, not merely as a "fragment of an animal," but in its bearing and function in the economy of the whole organism. This standpoint is noteworthy for its similarity to that adopted in two other masterpieces of physiological literature contributed by two previous Silliman lecturers. Krogh, like Sherrington in the "Integrative action of the nervous system" and Hal-

dane in "Respiration," recognizes that correlation and regulation are the prime problems of physiology.

The investigations by the author and his pupils, which form the larger part of the subject matter of this book, arose from the problem of the mechanism by which the exchange of substances and especially oxygen is effected between the blood and tissue elements. How is this function regulated, and adapted to the ever-changing needs and coordinated with the multifarious activities of the living body? The answer, which is one of the most beautiful of recent discoveries, is that in such a tissue as muscle there are many times as many capillaries as are ever opened simultaneously to the blood flow during rest; and that now one, now another channel is opened for short periods, to close again as yet others open. This alternation of dilatation and constriction is under a control which is largely local and is clearly dependent upon the needs of the immediately surrounding tissue elements. Only with the passage from rest to the activity of muscular work are all, or nearly all, of the capillary channels dilated. The surface for diffusion of oxygen and other nutriment is thus varied and adapted to the needs of the working muscle fibers. Spreading along and around the capillaries are the contractile elements which Krogh, in generous recognition of the investigator who first saw them, terms Rouget cells.

From the investigations of Krogh and his pupils and the work of others, which is fully reviewed, it is shown that the capillaries are contracted and dilated independently of the arterioles, and thus form a mechanism independent, in large part at least, from the vasomotor mechanism of Claude Bernard and Ludwig. Beside the heart and the vasomotor (arteriomotor) mechanism we must recognize a third and no less important factor in the circulation, consisting of the capillariomotor mechanism: a conception which the reviewer urged as necessary years ago (on much less conclusive evidence however) and called the "venopressor" mechanism, but which was then too unorthodox for some authorities.

Many suggestive observations are here reported also on the reactions of capillaries to stimuli on their part in herpes zoster and erythema, and on their behavior under the influence of heat and cold and in reaction to chemical substances, and especially to histamine.

These investigations do not yet solve the problem of functional hyperemia—the cause and mechanism of the dilatation of all the capillaries of a muscle, for instance, when it is working. But they formulate clearly the problem and take a first step towards its solution; for the discovery is reported and established of a special hormone, identical apparently with that in pituitary extract, which exerts, above every other substance tested, a capillary dilating power.

Two lectures are devoted to the topic of the exchange of substances through the capillary wall—a topic of fundamental importance, upon which many keenly conceived and beautifully executed observations are described, together with stimulating new conceptions of the process of intravital diffusion.

In the last lecture the parts played by capillaries in various processes in health and disease are discussed. The topics include the absorption of dissolved substances from the small intestine, the regulation of the aqueous humor of the eye, inflammation—that supreme problem of pathology, circulatory shock—a scarcely less interesting problem for physiology, and finally the formation and reabsorption of edema.

Clear in conception, method and presentation, and beautiful in the technique both of the laboratory and of the printing press, this book is indeed a worthy addition to the scientific classics which have been published as Silliman lectures. It presents investigations already crowned by the Nobel prize.

YANDELL HENDERSON
YALE UNIVERSITY
NEW HAVEN, CONN.

Tobacco and Mental Efficiency. M. V. O'SHEA. Macmillan Company, 1923, pp. xx and 258.

THIS is a general and popularly written report of the outcome of various inquiries supported by the "Committee to Study the Tobacco Problem." It is an unbiased account of the present state of our knowledge concerning the title subject.

The first third of the book gives an interest-

ing survey of the tobacco habits and opinions of prominent men and women, and cites testimonials typical of those received from several hundred distinguished persons, both smokers and non-smokers. The net results are (a) that such reports do not yield reliable information concerning the influence of tobacco; (b) that unexpected numbers and natures of people smoke; (c) that there is a general objection to the juvenile use of tobacco.

A second section of the book reports studies of the correlation between school work and the use of tobacco. Questionnaire returns and statistical studies, which are cited, show that, on the whole, school men agree that smoking and scholarship are incompatible, but the causal relations are obscure. Comparison of scholarship records with smoking proclivities yields a correlation of —.51. Among high school boys examined the smokers were found to be superior in intelligence tests. They thus fail to live up to their possibilities and the teachers put a good share of the blame on tobacco. Of course a correlation does not reveal causality, but it would at least appear from the data that something is operating to disinterest the more intelligent boys in scholarship and to attract them to tobacco.

Realizing the insufficiency of the foregoing data, the author devotes the last third of the book to a survey of the experimental studies of Dr. Clark L. Hull, detailed report of which is promised in a forthcoming monograph. With well-controlled technique, experiments were conducted on eighteen men college students to determine the effect of pipe smoking on twelve different work processes.

On seven of these tasks the average results are so small or so equivocal as to be negative or uncertain. Steadiness, accuracy in cancellation and facility in learning show impairment. Pulse is increased in rate and motor fatigue is lessened (the sign for muscular fatigue average on page 222 should be + instead of —). The net result is loss rather than gain in performance. The book concludes with a judicious summary of conclusions and a fifteen page bibliography of English books and articles. Throughout the book is distributed also a good deal of discussion concerning the possibility of influences not yet experimentally demonstrated.

In common with most studies of drug effects, individual differences are noted and it is time that such idiosyncrasies be more fully analyzed. Drug investigations already reported provide data which suggests very clearly an inverse relation between susceptibility to drugs and general mental competence. If these indications are reliable it is not "people of distinction" and college students, but instead the mediocre and the natively inferior who may best reveal the characteristic direction and nature of drug influences.

H. L. HOLLINGWORTH
COLUMBIA UNIVERSITY

SPECIAL ARTICLES

ON AN APPARENT EFFECT OF THE SUN'S ELECTRICAL CHARGE ON THE YEARLY VARIATION OF ATMOSPHERIC POTENTIAL GRADIENT

IT has long been known that the electrical potential gradient in the atmosphere undergoes an annual variation, being greater in winter than in summer. It seems still to be generally believed that this variation is due to a corresponding variation in electrical charges situated somewhere in the atmosphere, though all attempts to locate these charges have failed. On the other hand, Erman[1] showed in 1803 that all known phenomena of atmospheric electricity could be explained as due to induction by a negatively electrified earth. A similar theory was proposed by Peltier in 1836. In 1874 Sir William Thomson (Lord Kelvin) in his presidential address before the Society of Telegraph Engineers said:[2]

> I do not say too much, then, when I say that the statement that the air is positively electrified has been at all events a subject for ambiguous and contradictory propositions; in fact, what we know by direct observations is that the surface of the earth is negatively electrified, and positive electrification of the air is merely inferential.

And again,

> The result that we obtain every day of fair weather in ordinary observations on atmospheric electricity is precisely the same as if the earth were electrified negatively and the air had no electricity whatever.

[1] Gilbert's Annalen, xv, 386.

[2] *Soc. Telegraph Eng. Jour.*, Vol. III, p. 12.

The extensive work of Franz Exner has led him to the same conclusion, so that Erman's theory of atmospheric electricity seems at least worthy of careful consideration.

Attention has previously been called by the present writer to his conclusion that the negative charge of the earth is repelled by a similar charge on the sun. This would result in both a diurnal and a seasonal variation of the electrical potential of the earth at any given place. The diurnal variation has now been recorded almost continuously by photographic methods for two and one half years at Palo Alto. The records show that, in general, the day side of the earth is electropositive to the night side.

A similar annual variation would necessarily follow from the interpretation which I have put on these results. In this case, the winter hemisphere of the earth should be electronegative to the summer hemisphere. Assuming the correctness of Erman's interpretation of the atmospheric potential gradient, this gradient should accordingly be greater in winter than in summer, and it should vary in some manner with the altitude of the sun.

Since only that component of the sun's inductive repulsion which acts toward the north or south would displace the earth's charge in these directions, and since this component must vary as the sine of the angle of the sun's declination from the vertical at any given place, it would seem that the diurnal variation of the atmospheric potential gradient at that place should, if undisturbed by other causes, vary approximately as the sine of the angle of solar declination.

It is known that measurements of the potential gradient give everywhere very irregular results. If the potential gradient is due to the induction of the earth's charge it should have a maximum value if the air were a perfect insulator, and would be zero if the air were a conductor. The air is a very good, though, owing to its containing always some free ions, not a perfect insulator. Its conductivity is too small to admit of direct measurement, but it may be computed from the number and mobility of the free ions which are found in it. Since the amount of its ionization varies, the conductivity of the air is likewise variable, and the potential gradient, which should vary in the opposite direction to the conductivity if it is an inductive phenomenon, should also be variable.

In a recent series of balloon measurements of both atmospheric conductivity and potential gradient which were carried to an altitude of about nine kilometers, Wigand[3] found the product of the potential gradient into the conductivity of the air to be nearly a constant at a given elevation, but to fall off with the altitude at the rate of about two per cent. per kilometer.

It is customary to call this product of the potential gradient into the conductivity of the air the "earth-air current." This hypothetical current is very small, amounting to about 1/100,000 ampere over a square mile of the earth, but it is regularly computed at some observatories. Now it is quite possible to give a different interpretation to this quantity. Thus, if the potential gradient varied inversely as the conductivity, the product of these two quantities would be the true potential gradient for some uniform condition of conductivity taken as unity, and it is this true potential gradient which should vary with the sun's declination.

Observatorio Del Ebro, at Tortosa, Spain, publishes tables of the mean monthly values of the earth-air current, and Figure 1 gives a comparison of the mean of these monthly values for the six years, 1914-19, with the monthly values of the sine of the angle of solar declination at Tortosa. The continuous line represents the mean values of the earth-air current, and the dotted line the values of the sines of solar declination for the corresponding months.

On page 715 of Hann's *Lehrbuch der Meteorologie* is given what is said to be the mean yearly variation of the atmospheric potential gradient for the north temperate zone between the parallels of 45° and 50° N. In Figure 2 the mean monthly values given in Hann's table are compared with the monthly sines of the angles of solar declination for latitude 47½° N. Here, as in Figure 1, the continuous line represents the atmospheric potential gradient.

In the southern hemisphere the same law seems to hold, though much less data on potential gradients are available from the southern

[3] *Ann. d. Phys.*, lxvi, 81; *Phys. Zeitsch.*, xxii, 623.

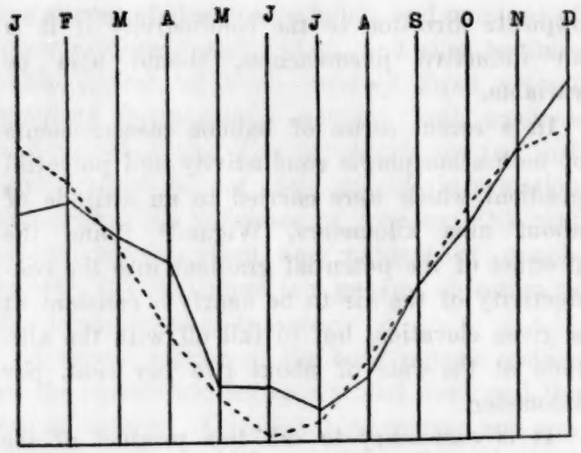

FIGURE 1. Relation of earth-air electric current to sine of angle of solar declination at Tortosa.

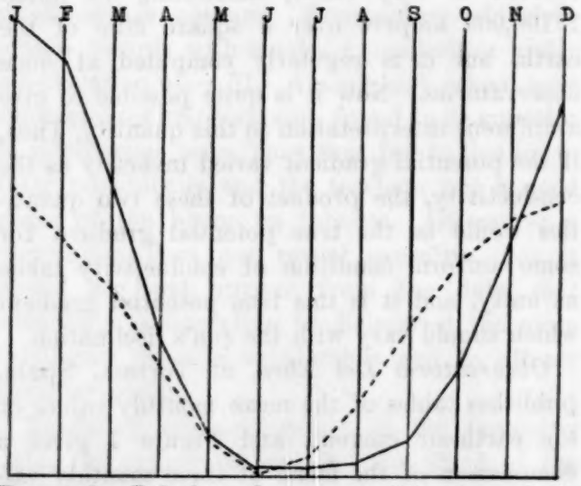

FIGURE 2. Relation of mean monthly atmospheric potential gradient to sine of solar declination for the region between 45° and 50° north latitude.

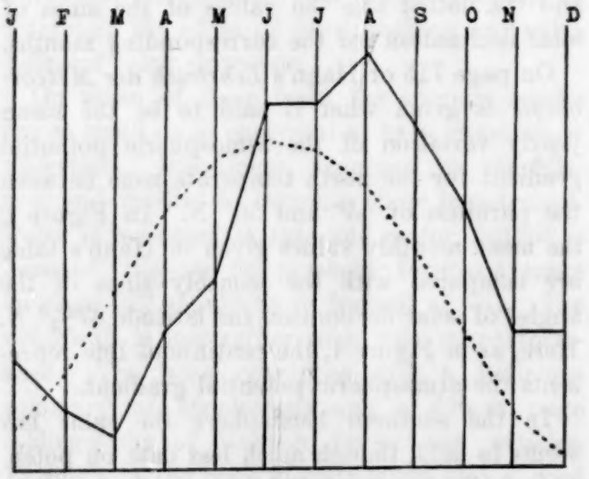

FIGURE 3. Relation of mean monthly potential gradient to sine of solar declination at Melbourne, latitude 37° 50′ south.

than from the northern hemisphere. The monthly potential gradient at Melbourne (Lat. 37° 50′ S.) is given in Hann's *Lehrbuch* and in Arrhenius' *Kosmische Physik*, p. 889. In Figure 3 this data is compared with the corresponding monthly values of the sine of the angle of solar declination for that latitude. The continuous line, as before, represents the atmospheric potential gradient.

In the case of Figure 3 the agreement between the two quantities is not as close as in figures 1 and 2, the data on potential gradient being more irregular than in the other cases. It seems probable that if the conductivity of the air at Melbourne were known, so that the earth-air current could be computed, it would, at least, give a smoother curve.

A more conclusive test of the theory should be given by a station near the Equator, where the curve for the sine of the solar declination must have two maxima and two minima during the year. A case of this kind may be found in the data from Batavia which are given by Hann and Arrhenius. The two curves for Batavia are given in Figure 4, their significance being the same as in the other curves given, the latitude of Batavia being taken as 6° S.

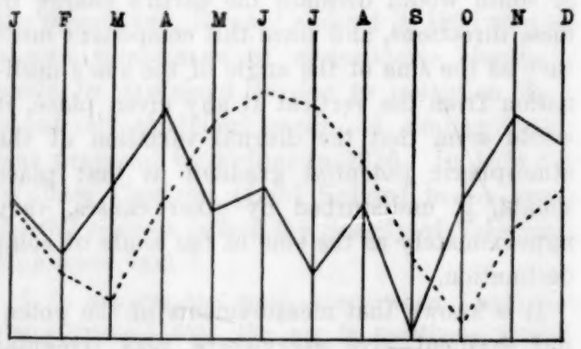

FIGURE 4. Relation of mean monthly atmospheric potential gradient to sine of angle of solar declination at Batavia, latitude 6° S.

The above comparisons seem to the writer to show that the yearly variation of the atmospheric potential gradient, especially when corrected for atmospheric conductivity, is such as would be expected to result from a negatively charged earth under the inductive influence of a similarly electrified sun.

FERNANDO SANFORD.

PALO ALTO, CALIFORNIA,
JANUARY 15, 1923

THE TWENTIETH ANNIVERSARY OF THE SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE

A PRELIMINARY conference relative to the organization of the Society for Experimental Biology and Medicine took place at the residence of Professor Graham Lusk on January 19, 1903, the first meeting being held in the laboratory of physiological chemistry, College of Physicians and Surgeons, Columbia University, February 25, 1903. The society was founded by the late Dr. Samuel J. Meltzer, who was elected its first president. The object of the society was stated to be the cultivation of the experimental method of investigation in the sciences of animal biology and medicine. There were nineteen charter members and during the first year fourteen additional resident members and twenty-three non-resident members were elected, making a total of fifty-six. At the end of the first ten years the membership had grown to two hundred and fifty-five and numbers at present five hundred and forty-nine. Somewhat less than one third of this number are resident members, the remainder being located in different parts of the United States and Canada and various foreign countries.

The society now possesses four branches formed by groups of members who hold independent meetings, the scientific transactions of which appear in the *Proceedings*. The Pacific Coast Branch was formed in 1912, the Minnesota Branch in October, 1921, the Western New York Branch in February, 1922, and the Peking (China) Branch in December, 1922.

The *Proceedings* of the Society for Experimental Biology and Medicine gives in concise form the papers presented before the society and its branches. It is published monthly from October to May, the current volume numbering about 500 pages. About two years ago, following the death of Dr. Meltzer, members of his family started a fund for the endowment of the *Proceedings*. Through the gift of friends and members of the society this memorial fund now amounts to about $5,500. The society plans to increase this to $10,000.

The one hundred and thirty-first and twentieth annual meeting of the society was held in the biological lecture room of the College of the City of New York at 5 P. M. on April 18, 1923, with an attendance of about 100.

The following papers were presented:

Chemical changes in the blood in intestinal obstruction: J. F. CONNORS, J. A. KILLIAN and H. B. EISBERG.

Metabolism of cystin: G. J. SHIPLE, A. R. ROSE and C. P. SHERWIN.

A micro colorimetric method of estimating the hydrogen ion concentration of the blood: V. C. MYERS, H. W. SCHMITZ and LELA E. BOOHER.

Some studies on the vital staining of the blood cells: R. SPIRIDONOVITCH (by invitation).

Reductional changes in dying protoplasm: ROBERT CHAMBERS.

The influence of nutrition during the pre-experimental period on the development of rickets in rats: ALFRED F. HESS and M. WEINSTOCK.

The various forms of phosphoric acid in the blood. Findings in rickets: T. F. ZUCKER and MARGARET GUTMAN.

Observations on the distribution of antirachitic substances: T. F. ZUCKER and MARION BARNETT.

On the nature of the immunizing antigen of pneumococcus: WILLIAM A. PERLZWEIG and GUSTAVE I. STEFFEN (by invitation).

Indican influence by bacillus acidophilus therapy: LILLIAN SEGAL KOPELOFF and NICHOLAS KOPELOFF.

Papers read by title were:

The effect of treatment of rickets in animals and children by the yolk of egg: JOHN HOWLAND and BENJAMIN KRAMER.

Leucocytes in relation to the mechanism of thyroid-accelerated metamorphosis in the larval frog: H. E. JORDAN and C. C. SPEIDEL.

Light as a factor in fish dispersal: F. E. CHIDESTER.

The respiratory exchange of normal and diabetic men following the administration of insulin and epinephrin: RICHARD S. LYMAN, ELIZABETH NICHOLLS and WM. S. MCCANN.

The effect of thyroid products on paramecium: L. L. WOODRUFF and W. W. SWINGLE.

The effect of ultra-violet rays on rats in the circular maze: DAVID I. MACHT and ELMER J. TEAGARDEN, JR.

The occurrence of intranuclear inclusion bodies in certain tissues of the rabbit inoculated directly with the virus of herpes labialis: E. W. GOODPASTURE and OSCAR TEAGUE.

Following the scientific session the annual dinner was held in the faculty dining room of the City College, with an attendance of forty-one members.

Dr. Holmes C. Jackson of the University and Bellevue Hospital Medical College, who has served as secretary-treasurer of the society and

managing editor of the *Proceedings* for the past ten years, was elected president to succeed Dr. George B. Wallace. Other officers elected were vice-president, James W. Jobling, Columbia University; secretary-treasurer, Victor C. Myers, New York Post-Graduate Medical School and Hospital; additional member of the council (for 2 years), Stanley R. Benedict, Cornell University Medical College. The term of Eugene F. Du Bois as councilor expires in 1924.

The nominating committee elected for 1924 were A. J. Goldfarb, Graham Lusk, D. D. Van Slyke and G. B. Wallace, resident members; A. J. Carlson, L. B. Mendel and A. N. Richards, non-resident members.

The chairmen of the different branches and *ex-officio* vice-presidents of the society are: Pacific Coast Branch, William Ophüls, Stanford University Medical School; Minnesota Branch, Arthur D. Hirschfelder, University of Minnesota; Western New York Branch, John R. Murlin, University of Rochester; Peking Branch, Carl Ten-Broeck, Peking Union Medical College.

THE AMERICAN MATHEMATICAL SOCIETY

THE fifty-first regular meeting of the Chicago Section of the American Mathematical Society, constituting the nineteenth western meeting of the society, was held at the University of Chicago on Friday and Saturday, April 13 and 14. On Friday afternoon, Professor S. Lefschetz, University of Kansas, gave a lecture on "Curves traced on algebraic surfaces." About sixty persons were present at a dinner at the Quadrangle Club on Friday evening. The Section voted to hold its Christmas meeting in Cincinnati in affiliation with the American Association for the Advancement of Science.

The following papers were read at this meeting:

On the representation of a certain fundamental law of probability of Laplace: H. L. RIETZ.

An application of areal coordinates to mixtures and the graphical solution of equations: F. E. WOOD.

Riemann surfaces and the map problem: H. R. BRAHANA.

A theorem concerning unit matrices with integral elements: H. R. BRAHANA.

An application of fractional differentiation to a class of Volterra integral equations: H. T. DAVIS.

Same left co-set and right co-set multipliers for any given finite group: G. A. MILLER.

The linear group modulo p_K: M. M. FELDSTEIN.

Continuous transformations of manifolds: S. LEFSCHETZ.

Certain limitations of the value of the complete independence of a set of postulates: M. H. INGRAHAM.

Foundation and status of the theory of linear algebras: L. E. DICKSON.

General theory of hypercomplex integers: L. E. DICKSON.

The optical transformation of surface differentials: IRWIN ROMAN.

Solutions of ordinary differential equations: F. R. MOULTON.

On approximation by functions of given continuity: DUNHAM JACKSON.

Vector treatment of the extrema of double integrals: D. C. KAZARINOFF.

Cubics associated with a net of conics: F. E. WOOD.

An extension of the theory of the double modulus: J. S. TURNER.

On certain properties of sets of positive measure: H. BLUMBERG.

On a class of invariant subgroups of the conformal and projective groups in function space: I. A. BARNETT.

The area preserving group in function space: I. A. BARNETT.

The papers of Professors Blumberg and Barnett were read by title.

ARNOLD DRESDEN
Secretary of the Chicago Section

THE MICHIGAN ACADEMY OF SCIENCE, ARTS AND LETTERS

THE twenty-eighth annual meeting of the Michigan Academy of Science, Arts and Letters was held in Ann Arbor March 28-30, 1923. The presidential address was given by R. A. Smith, state geologist of Michigan, on "The land-economic survey of Michigan." At the first general session memorials to the two past-presidents who had died during the year, Leroy H. Harvey and Walter B. Barrows, were presented. At the same meeting a paper, "The

length of geological time based on observations within the field of physical geology," was given by H. H. Hobbs. The programs of the scientific sections follow:

SECTION OF ANTHROPOLOGY

The physical culture of the Michigan Indians: W. B. HINSDALE.

An archeological survey of Berrien County, Michigan: GEO. R. FOX.

The human and associated animal remains of the Kentucky Caves: ARTHUR M. MILLER.

Folk-lore of fossils in Greek and Latin: EUGENE S. MCCARTNEY.

The stone cave temple of Kyungju, Korea: W. CARL RUFUS.

Food plants of the Polynesians and their bearing on route and time of migration: FORREST B. H. BROWN.

The food prohibitions and guardian spirits of the Exogamous Septs of the Batak: H. H. BARTLETT.

SECTION OF BOTANY

The heart-rot of black ash caused by Polyporous hispidus (Fr. with lantern): DOW VAWTER BAXTER.

Imperfect stages of some higher pyrenomycetes obtained in culture: LEWIS E. WEHMEYER.

A native homothallic mucor: BESSIE B. KANOUSE.

Longevity in spores of Aspergillus Oryzae and Rhizopus Nigricans: ADELIA MCCREA.

The production of improved strains of Hevea brasiliensis: CARL D. LARUE.

Notes on the failure of seed crop of Hevea brasiliensis on east coast of Sumatra: CARL D. LARUE.

The nuclear-chiaera theory of inheritance in Oenothera: H. H. BARTLETT.

The vernacular names of certain Sumatra plants: H. H. BARTLETT.

Notes on the orange rust of Rubus: E. A. BESSEY.

Native Michigan shrubs for ornamental use: E. GENEVIEVE GILLETTE.

Observations on the poisonous plants of Michigan: E. F. WOODCOCK.

Vegetable zones in the Western Himalayas (with lantern): L. A. KENOYER.

Distribution of umbellales in Michigan: L. A. KENOYER.

Distribution of ericales in Michigan: L. A. KENOYER.

Meteorological data, Douglas Lake, Michigan, 1922: F. C. GATES.

Swamp and bog plants: Iris versicolor: F. C. GATES AND ELSIE E. ERICKSON.

Annual growth of Pinus resinous and Pinus strobus near Douglas Lake, Michigan: DOROTHY J. CASHEN.

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CARL D. LARUE
Secretary